Comparative study between the effect of intermittent and hospital blended enteral feeding on intensive care patients' outcomes

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Abstract

Background: Patients treated in the intensive care unit require enteral feedings to maintain adequate nutrition during critical illness. **Aim of the study:** to compare the effect of intermittent enteral feeding by using syringe pump versus hospital blended formula by using feeding bag on patients' outcomes. **Setting:** was carried out in three settings at Assiut university hospital. **Sample:** A randomized controlled experimental study in which seventy patients were selected by convenience sampling and assigned into two equal groups (35 patients each). Both groups received 2000 ml of feed per day and the same formula per day which was 30-35ml/kg of water, 1.5 g/kg of protein. The only manipulation was in the flow rate and the device by which the feed was administered. **Tools:** The three tools used in this study were developed by the researcher based on reviewing of the literatures. The first tool was general assessment sheet, the second tool is the feeding assessment sheet, The third tool is Patients' outcomes evaluation sheet **Results:** There were significant statistical differences between the outcomes of the two groups. The complications in the intermittent enteral feeding group were lower than those in feeding bag group as in gastrointestinal (P<0.001), mechanical (P=0.033) and metabolic complication (P0.005). **Conclusion:** intermittent enteral feeding by using syringe pump is extremely effective in reducing complications and improving the nutritional status among ICU patients. **Recommendations:** Intermittent enteral feeding should be used as a standard enteral feeding for patients in the ICU.

Keywords: Enteral feeding, Patient's outcomes, Critically ill, Complications

Introduction

Enteral nutritional support refers to the provision of calories, protein, electrolytes, vitamins, minerals, trace elements, and fluids via the gastrointestinal route. Enteral feeding is indicated for patients with a functional gastrointestinal tract whose oral nutritional intake is insufficient to meet estimated needs **(Can, 2010)**.

Age-related changes that occur for older adults in muscle mass and body composition in combination with medical comorbidities such as stroke, dementia, and depression place them at

high risk for developing malnutrition and frailty (**Mundi et al., 2018)**

Older adult patients when admitted to the ICU, can be assumed to be losing their muscle mass, inability to recover muscle mass due to muscle disuse, increase the risk of frailty development on discharge from the ICU, and become anabolically resistant that meaning they will have a lower skeletal muscle protein synthetic. **(Phillips et al., 2017).** The skeletal muscle wasting and weakness are more common associated with a prolonged need for mechanical ventilation; therefore, adequate nutrition therapy is important as an integral part in the treatment of critically ill patients **(Chinda et al., 2020).**

Enteral nutrition therapy has a number of advantages over parenteral nutrition in the management of patients requiring nutritional support. Enteral nutrition aids in the preservation of gastrointestinal function by the provision of enteral nutrients and is easier, safer and less costly to administer, understanding the molecular and biological effects of nutrients to maintain homeostasis in the critically ill population is important **(Jazayeri1 et al., 2016 and Heyman et al., 2004).**

However, despite these relative advantages, the delivery of safe and effective enteral nutrition therapy may still present challenges for families and caregivers in terms of time, technical expertise, and cost **(O'Leary-Kelley and Bawel, 2017 and Heyman et al., 2004**).

Due to advances in technology of enteral feeding tubes and delivery systems, specialization of health professionals, and better education of parents and caregivers, the administration of enteral nutrition has been associated with improved clinical outcome and safety profiles. Enteral nutrition therapy is easier and safer to administer than parenteral nutrition. Not only are the risks of intravenous access avoided, but there is also a wider margin for error with most metabolic complications. As a result, enteral nutrition therapy is easier to administer in low-intensity hospitals and patient care settings, including the home. However, compared with normal diet, tube feedings require extra time and effort to administer and this additional care need may contribute to increased burden and stress for families and caregivers **(McClave and Taylor 2016 and Heyman et al., 2004).**

Enteral nutrition (EN) can be administered using various methods such as continuous, cyclic, intermittent, and bolus techniques, either alone or in combination. In continuous feeding, an hourly rate of EN is administered using a feeding pump over 24 h. In cyclic feeding, EN is administered via a feeding pump in less than a 24-h time period. In intermittent feeding, EN is administered over 20-60 min every 4-6 h with or without a feeding pump. In bolus feeding, EN is administered via a syringe or gravity drip over a 4-10-min period **(Ichimaru, Amagai, 2015; Van Blarcom and McCoy 2018)**.

A number of factors are taken into consideration when selecting EN delivery modalities, such as the medical

condition of the patient, expected tolerance to tube feeding, location of the feeding tube tip, type of formula used, nutritional requirements, mobility of the patient, availability of electric feeding pump, and cost. However, too little data are available at present to make a strong recommendation for one particular method of enteral feeding over others. In practice, it is generally considered acceptable for pump-assisted continuous feeding in critically ill patients to be initiated at a rate of 10-20 ml/h and then gradually increased to the target rate. For medically stable patients, intermittent and bolus feeding methods are preferred due to practical issues, such as patient mobility, convenience, and cost. **(Villar-Taibo 2017**) At present, no evidence is available regarding the optimum feeding modality for not only an ordinary clinical setting but also critical care setting especially in the ICUs **(Ichimaru S., Amagai T., 2015)**.

Nurse is the closest care provider for critically ill patients and has a crucial role in nutritional care, such as nutrition assessment, assessment of energy and nutritional requirements, prefeeding readiness assessment, the execution of enteral feeding, assessing the adequacy calories target starting and managing enteral feeding, and monitoring patients for potential complication **(Rosdahl C, Kowalski M., 2012).**

This study was designed as a randomized controlled trial to compare the effect of intermittent enteral feeding by using syringe pump versus hospital blended feeding by using feeding bag on the nutritional status and complications among ICU patients.

The Aim of the Study:

To compare the effect of intermittent enteral feeding by using syringe pump versus hospital blended formula by using feeding bag on patients' outcomes..

Research hypothesis:

1- Nutritional status in critically ill patients that had intermittent enteral feeding by using syringe pump will be significantly improve than patients had hospital blended feeding by using feeding bag.

2- Complications in critically ill patients had intermittent enteral feeding by using syringe pump will be significantly reduce than patients who had hospital blended feeding by using feeding bag.

3- The duration of mechanical ventilation in critically ill patients that had intermittent enteral feeding by using syringe pump will be significantly reduce than patients who had hospital blended feeding by using feeding bag.

Subjects and Methods:

Research design: The current study was a randomized controlled experimental study in which a prospective single-center randomized parallel group trial registered at www. clinicaltrials. gov (NCT04576234).

Setting of the study: This study was carried out in three settings included critical, general and trauma intensive care units at Assiut university hospital.

Sample: seventy patients were selected by convenience sampling and

assigned into two equal groups (35 patients each).

Sample size calculation:

- A power calculation estimated that in order to detect an effect size of 0.29 difference in mean of abdominal distension between the two studied groups, **(Mahran et al., 2019)** with a p-value < 0.05 and 80% power, confidence level 0.95, a sample size of 34 patients for each group was needed. However, 70 patients were attempted in this research work to avoid non-response rate (35 for each group). This calculated using G Power 3.1 **(Hsieh et al., 1998)**.
- Patients were allocated in 1: 1 ratio into the two study groups using a web-based randomizer (https:// www. randomizer. org/) to generate codes placed within sealed, opaque, sequentially numbered envelopes to assign patients into intermittent enteral feeding (IEEF) group or feeding bag (FB) group . All patients, both sex indicated for enteral feeding were enrolled in this study. The study was conducted between October 2019, and February 2020.

Study tools: The three tools used in this study were developed by the researcher based on reviewing of the literatures. **The first tool** was general assessment sheet used to monitor hemodynamic parameters included (mean arterial pressure (MAP) taken from bed side monitor, heart rate (HR), temperature, respiratory rate and CVP readings, physical examination done every day and included neurological examination and chest examination regarding disturbances, chest x-ray assessment, mode of ventilation and duration of mechanical ventilation, fluid balance assessment., assessment of laboratory findings in addition to socio-demographic and medical data.

The second tool is the feeding assessment sheet used to assess BMI after assessing height and weight; assessment of amount of water, protein, calories given per day; assessment of mode of enteral feeding ; residual volume assessment; period of feeding rest and frequency .

The third tool is Patients' outcomes evaluation sheet used to assess patients' outcomes includes nutritional status, duration of mechanical ventilation and complications.

Methods

The study was conducted throughout three main phases, which were preparatory phase, implementation phase and evaluation phase:

1- Preparatory phase:

Seeking official and non-official permission to conduct the study were obtained by the researcher from the head of all intensive care units after explanation of aim and nature of the study.

Construction for data collection tools after extensive literature of review.

Content validity: The tools were tested for content related validity by jury of 5 specialists in the field of critical care nursing and critical care medicine from Assiut University then

the tools were designed in their final format and tested for reliability using internal consistency for all of the tools which was measured using cronbach`s test. The tools proved to be reliable (α 0.823).

1- **A pilot study**: was conducted on 10 patients to test the feasibility and applicability of the tools and the analysis of the pilot study revealed that minimal modifications are required, these necessary modifications were done and the pilot study subjects were excluded from the actual study.

2- **Ethical consideration:-**

Research proposal was approved from Ethical Committee in the faculty of nursing. The study protocol was approved by Ethics Committee of the faculty of nursing (2250037).

- There was no risk for study subject during application of the study.
- The study followed common ethical principles in clinical research.
- Written consent was obtained from patients or guidance that participated in the study, after explaining the nature and purpose of the study.
- Patient was assured that the data of this research was not be reused without second permission.
- Confidentiality and anonymity was assured.
- Patients had the right to refuse to participate or withdraw from the study without any rational at any time.

Data collection: The data were collected from the first day of admission after stabilization of the patient's condition and extended to 7 days, every day then the data were recorded in the developed tools.

II-Implementation phase:

- Firstly socio-demographic data and medical data was obtained by the researcher by using tool (1) for both groups.
- Assessment of the two groups was done by using tool (1).
- After getting ethical clearance patients were enrolled in the study, Following an initial assessment, the patients were assigned to intermittent enteral feeding (IEEF) or feeding bag (FB) groups by block randomization:

1- Intermittent enteral feeding (IEEF) group: received intermittent feeding as the feed was given over a 24-hour period with intervals of rest (e.g. three hours feeding two hours rest) by using syringe pump.

2- Feeding bag (FB) group: received hospital blended formula which was 300 ml of feeds every 2hrs with 4hrs rest at night and given in 10 minutes with following the same guidelines in the intermittent enteral feeding group.

- Both groups received 2000 ml of feed per day and the same formula per day which was 30-35ml/kg of water, 1.5 g/kg of protein. The only manipulation was in the flow rate and the device by which the feed was administered.

- Feeds were administered according to guidelines as the head of the patient's bed was elevated at least 30 degrees from the horizontal before initiating feeding, the feeding schedule was started at a rate of 50 ml/hr. in adults to promote tolerance, the administration rate of isotonic formulas increased in 20-25 ml/hr. increments every eight hours until the desired rate was achieved, the tube was flushed regularly with 20 to 30 ml of warm water every four hours during continuous feeding and before and after intermittent feeding and medication administration, the gastric residual volume was checked every 4-6 hr. routinely.

III- Evaluation phase:

This phase was done to evaluate and compare the effect of applying intermittent enteral feeding by using syringe pump and hospital blended feeding by using feeding bag on patients' outcomes (nutritional status, duration of mechanical ventilation and complications) and each patient was evaluated 3 times from admission till discharge (in the first day of the study, 4^{th} day of the study and in the last day of the study).

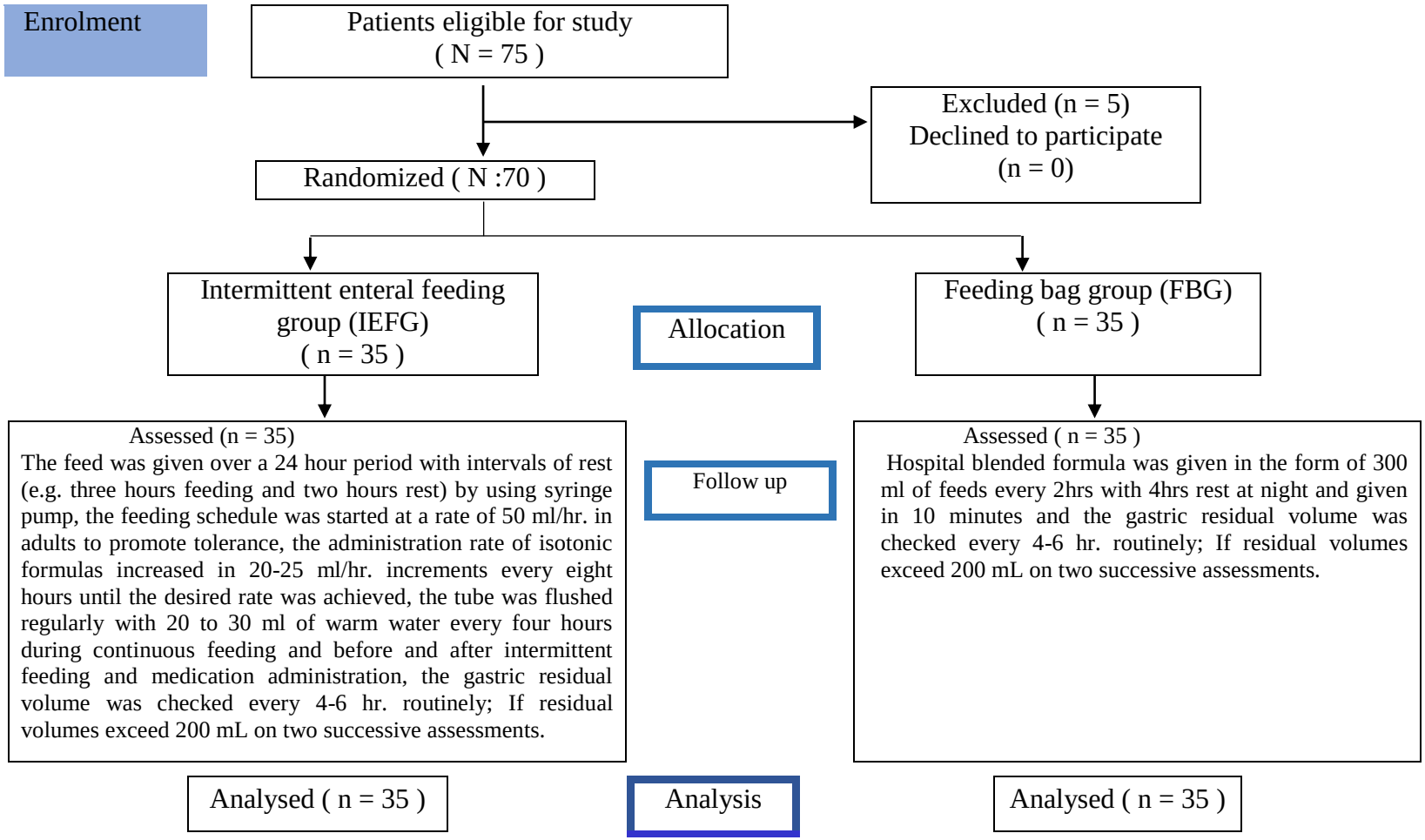

Fig. 1. CONSORT flow diagram of randomized controlled trial.

Data Analysis

Data were computerized and analyzed by computer programmed SPSS (ver.16). Data were presented by using descriptive statistics in the form of frequencies and percentages or means ± standard deviations for qualitative data. Quantitative data were compared using Independent samples t-test for comparisons among two groups. Qualitative variables were compared using chi-square test to determine significance. The critical value of the tests "P" was considered statistically significant when P less than 0.05.

Results

Table (1): Distribution of patients characteristics of feeding bag group (FBG) and intermittent enteral feeding group (IEFG)

Patients characteristics	FBG (n=35) No (%)	IEFG(n=35) No (%)	P. value
Age group			
from18- to 35 years	8(22.86)	10(28.57)	0.987
From 36- 55 years	8(22.86)	7(20.00)	
More than 55 years	19(54.29)	18(51.43)	
Mean+SD	51.94±14.44	51.89±14.40	
Sex			
Male	22(62.86)	25(71.43)	0.611
Female	13(37.14)	10(28.57)	
Present illness			
Peripheral edema	4(11.43)	10(28.57)	0.133
Cerebral disease	11(31.43)	13(37.14)	0.611
Pneumonia	5(14.29)	6(17.14)	0.265
COPD	6(17.14)	1(2.86)	0.198
HTN emergency	6(17.14)	2(5.71)	0.259
Trauma	10(28.57)	7(20.00)	0.578

Notes: Data is represented as number (percentage) or mean ± standard deviation COPD chronic obstructive pulmonary disease, HIN hypertension, p <0..05 statistical significant difference

Table (2): Distribution of feeding bag (FB) and intermittent enteral feeding (IEF) regarding hemodynamic parameters

Hemodynamic parameters	**FBG (n=35)** Mean ±SD	**IEFG (n=35)** Mean ±SD	P. value
Heart rate			
First day	111.43±24.59	103.5±30.92	0.276
4th day	108.67±21.34	99.03±28.9	0.147
Last day	102.97±22.05	94.13±23.2	0.136
Temperature			
First day	37.82±0.82	37.52±0.97	0.195
4th day	37.61±0.5	37.32±0.41	0.019*
Last day	37.47±0.58	37.21±0.19	0.023*
MAP			
First day	70.97±15.13	81.37±19.73	0.026*
4th day	75.23±10.99	82.9±15.96	0.034*
Last day	74.27±10.62	79.33±14.84	0.134
Respiratory rate			
First day	23.07±8.45	22.73±10.43	0.892
4th day	20.73±6.73	18.47±6.6	0.193
Last day	18.7±5.69	16.53±4.58	0.109
CVP			
First day	8.77±5.71	11.9±6.6	0.054
4th day	10.23±4.6	11.77±4.43	0.194
Last day	11.67±4.8	11.4±2.85	0.795
GCS			
First day	9.73±4.06	10.63±3.35	0.353
4th day	11.47±3.35	11.87±3.2	0.638
Last day	12±3.19	12.77±3.04	0.345
Height	163.13±11.07	165.63±6.13	0.284
Weight	81.9±13.06	78.9±11.87	0.356
BMI	31.01±6.1	28.68±3.58	0.077

Note: Data is represented as mean ± standard deviation, p <0..05 statistical significant difference **-MAP:** mean arterial pressure **-CVP:** central venous pressure **-GCS:** Glasgow coma scale **-BMI:** body mass index

Table (3): Distribution of feeding bag (FB) and intermittent enteral feeding (IEF) groups according to physical examination in the first day, 4th day and the last of the study.

	First day			4th day			Last day		
	FB	IEF	P. value	FB	IEF	P. value	FB	IEF	P. value
	No (%)	No (%)		No (%)	No (%)		No (%)	No (%)	
Chest Examination									
Normal	8(22.9)	17(48.6)	0.025*	17(48.6)	22(62.9)	0.229	18(51.4)	25(71.4)	0.086
Wheezing	15(42.9)	13(37.1)	0.626	13(37.1)	10(28.6)	0.445	16(45.7)	7(20.0)	0.022*
Bronchospasm	9(25.7)	11(31.4)	0.597	8(22.9)	7(20.0)	0.771	3(8.6)	4(11.4)	0.690
Crepitation	14(40.0)	5(14.3)	0.016*	8(22.9)	1(2.9)	0.012	2(5.7)	1(2.9)	0.555
General appearance									
Anemia	5(14.3)	4(14.3)	1.000	2(5.7)	2(7.1)	0.817	1(2.9)	1(3.8)	0.847
Pallor	5(14.3)	4(14.3)	1.000	2(5.7)	2(7.1)	0.817	1(2.9)	1(3.8)	0.847
Jaundice	1(2.9)	1(3.6)	0.872	1(2.9)	2(7.1)	0.427	1(2.9)	1(3.8)	0.847
Cyanosis	1(2.9)	0(0.0)	0.367	1(2.9)	0(0.0)	0.367	1(2.9)	0(0.0)	0.378
Edema	32(91.4)	24(85.7)	0.473	32(91.4)	27(96.4)	0.419	32(91.4)	26(100.0)	0.208
Dry mucous membrane	12(34.3)	4(14.3)	0.070	12(34.3)	1(3.6)	0.003**	9(25.7)	0(0.0)	0.004**
Hydration	1(2.9)	0(0.0)	0.367	0(0.0)	0(0.0)	-	0(0.0)	0(0.0)	-
Site edema									
Lower limb	15(46.9)	11(45.8)	0.938	13(40.6)	16(61.5)	0.113	14(43.8)	21(80.8)	0.004**
Upper limb& lower limb	17(53.1)	13(54.2)		19(59.4)	10(38.5)		18(56.3)	5(19.2)	
Edema type									
Pitting edema	5(15.6)	3(12.5)	0.741	7(21.9)	2(7.7)	0.138	6(18.8)	2(7.7)	0.225
Not pitting edema	27(84.4)	21(87.5)		25(78.1)	24(92.3)		26(81.3)	24(92.3)	
Edema degree									
+1	15(46.9)	5(20.8)	0.052	8(25.0)	15(57.7)	0.007**	9(28.1)	21(80.8)	<0.001**
+2	11(34.4)	16(66.7)		17(53.1)	11(42.3)		17(53.1)	5(19.2)	
+3	6(18.8)	3(12.5)		7(21.9)	0(0.0)		6(18.8)	0(0.0)	
Method									

	First day			4th day			Last day		
	FB	IEF	P. value	FB	IEF	P. value	FB	IEF	P. value
	No (%)	No (%)		No (%)	No (%)		No (%)	No (%)	
MV	24(68.6)	22(62.9)	0.764	22(62.9)	21(60.0)	0.755	19(54.3)	18(51.4)	0.233
Oxygen mask	7(20.0)	8(22.9)		8(22.9)	9(25.7)		10(28.6)	6(17.1)	
Nasal cannula	0(0.0)	1(2.9)		0(0.0)	1(2.9)		1(2.9)	0(0.0)	
Rom air	4(11.4)	4(11.4)		5(14.3)	4(11.4)		5(14.3)	11(31.4)	
Mode									
SIMV-PC	4(16.7)	11(47.8)	0.049*	7(33.3)	8(38.1)	0.292	4(21.1)	8(42.1)	0.106
PCV	10(41.7)	8(34.8)		6(28.6)	6(28.6)		8(42.1)	6(31.6)	
CPAP	4(16.7)	0(0.0)		5(23.8)	1(4.8)		4(21.1)	0(0.0)	
BILEVEL	6(25.0)	4(17.4)		3(14.3)	6(28.6)		3(15.8)	5(26.3)	

Notes: Data is represented as number (percentage), p <0..05 statistical significant difference

Table (4): Comparison between feeding bag (FB) and intermittent enteral feeding (IEF) groups in relation to chest x-ray findings.

	FB(n=35)	IEF(n=35)	P. value
	No (%)	No (%)	
CXR Findings			
Normal	22(62.9)	21(60.0)	
Pneumonia	8(22.9)	13(37.1)	0.144
Pleural effusion	5(14.3)	1(2.9)	

Notes: Data is represented as number (percentage) or mean ± standard deviation where appropriate. **CXR** Chest x-ray ,p <0..05 statistical significant difference

Table (5): Comparison between feeding bag (FB) and intermittent enteral feeding (IEF) groups in relation to laboratory findings

	First day				Mid period				Last day			
	FBG (n=35)	IEFG(n=35)	Z	P.value	FBG (n=35)	IEFG(n=35)	Z	P.value	FBG (n=35)	IEFG(n=35)	Z	P.value
	Mean±SD	Mean±SD			Mean±SD	Mean±SD			Mean±SD	Mean±SD		
CBC												
HB	9.84±2.5	9.43±2.58	-0.828	0.407	9.99±1.91	10.47±1.62	-0.806	0.420	9.91±1.46	11.11±1.07	-3.345	0.001**
WBCs	12.43±6.66	17.45±8.76	-2.197	0.028*	12.59±4.86	14.11±8.47	-0.244	0.807	12.47±4.38	9.22±2.98	-2.879	0.004**
Platelets	297.14±124.62	196.7±108.23	-3.209	0.001**	291.3±133.52	199.37±76.71	-2.736	0.006**	296.54±123.04	222.5±68.64	-2.396	0.017*
Congelation Profile												
PT	17.88±14.69	17.12±7.31	-0.633	0.527	12.98±1.38	12.81±1.43	-0.598	0.550	12.6±1.12	12.45±1.32	-0.905	0.366
P.con	73.06±25.4	74.26±22.32	-0.141	0.888	89.55±17.88	91.52±14.26	-0.121	0.904	92.77±13.35	99.15±13.28	-1.365	0.172
INR	1.4±0.54	1.38±0.4	-0.290	0.772	1.14±0.23	1.09±0.16	-0.191	0.848	1.12±0.22	1.04±0.17	-1.685	0.092
Electrolytes												
Na	138.55±9.09	140.17±9.22	-0.740	0.459	139.1±8.38	139.56±4.34	-0.727	0.467	141.03±8.5	140.37±2.92	-0.297	0.767
K	4.03±0.64	3.69±1.08	-1.821	0.069	3.93±0.58	3.71±0.35	-1.933	0.053	4.04±0.96	3.88±0.29	-0.416	0.677
Ca	7.87±1.15	7.69±0.97	-0.888	0.374	8.42±0.73	8.67±0.49	-1.401	0.161	8.1±1.18	8.85±0.44	-2.887	0.004**
Mg	1.9±0.49	1.89±0.74	-0.222	0.824	1.87±0.43	2.02±0.27	-2.180	0.029*	2.3±1.31	2.01±0.13	-1.182	0.237
Renal Function												
Urea	8.22±8.13	6.79±8.2	-1.356	0.175	8.04±8.8	5.09±5.66	-1.951	0.051	6.58±6.46	4.08±2.51	-1.863	0.063
Creat.	99.83±151.39	108.23±99.91	-1.915	0.055	97.5±155.09	85.52±67.91	-1.790	0.074	77.7±98.54	73.4±31.72	-1.457	0.145
Liver functions												
Ast	123.5±183.84	71.33±153.76	-3.676	<0.001**	79.71±124.07	26.4±41.1	-3.929	<0.001**	55.18±62.76	16.03±11.27	-4.708	<0.001**
ALT	89.33±119.85	74.34±170.35	-3.454	0.001**	86.2±200.87	25.47±48.27	-3.646	<0.001**	52.87±79.33	14.42±14.44	-4.476	<0.001**
Albumin	28.07±7.43	24.17±5.25	-2.119	0.034*	26.6±5.51	32.23±5.64	-3.444	0.001**	26.43±5.96	36.6±3.87	-5.547	<0.001**
T.bilirubin	5.98±2.49	7.72±6.72	-0.245	0.806	6.95±4.15	5.79±3.05	-0.918	0.359	5.78±2.87	5.17±2.7	-0.610	0.542
Total protein	56.47±8.33	49.18±6.23	-3.627	<0.001**	53.34±13.04	58.2±4.15	-2.631	0.009**	53.64±8.72	62±4.93	-4.001	<0.001**
Glucose	6.57±3.29	5.35±1.23	-1.074	0.283	5.89±1.85	5.33±1.65	-1.007	0.314	5.95±2.11	5.69±1.4	-0.096	0.923
ABG												
PH	7.37±0.07	7.33±0.09	-1.364	0.173	7.37±0.06	7.38±0.04	-0.068	0.945	7.39±0.06	7.38±0.03	-0.045	0.964
$Paco_2$	30.33±12.82	32.43±11.01	-0.787	0.431	29.4±11.19	30.99±7.6	-1.306	0.191	30.13±8.5	33.77±6.32	-2.243	0.025*
Pao_2	126.33±48.3	114.75±36.47	-0.585	0.559	110.73±39.18	115.28±36.18	-0.995	0.320	103.13±30.42	113±35.18	-1.388	0.165
HCo3	21.23±7.19	18.74±5.54	-1.255	0.210	21.47±6.93	21.12±3.51	-0.114	0.909	24.59±7.01	23.41±3.18	-0.304	0.761
BE	-4.06±7.35	-6.62±5.93	-1.463	0.143	-3.68±6.91	-3.61±3.8	-0.554	0.580	-0.2±7.7	-1.28±3.1	-0.562	0.574

Note: Data is represented as mean ± standard deviation, p <0..05 statistical significant difference

Table (6): Comparison between feeding bag (FB) and intermittent enteral feeding (IEF) groups related to Intake, output and fluid balance.

	FBG (n=35)	**IEFG (n=35)**	**P.value**
	Mean±SD	**Mean±SD**	
Intake			
First day	4718.33±1595.71	4686.67±1364.26	0.934
4th day	4181.67±1314.08	4158.33±590.6	0.930
Last day	4166.67±1012.54	4106.67±504.59	0.772
Output			
First day	3278.33±1690.93	3185±1650.87	0.829
4th day	3580±1910.52	3318.67±1143.82	0.523
Last day	3561.67±1564.29	3416.67±875.46	0.659
Balance			
First day			
+VE	32(91.4)	30(85.7)	
-VE	3(8.6)	5(14.3) 0.710	
4th day			
+VE	28(80.0)	30(85.7) 0.752	
-VE	7 (20.0)	5(14.3)	
Last day			
+VE	25(71.4)	29(82.9)	0.394
-VE	10(28.6)	6(17.1)	

Notes: Data is represented as number (percentage) or mean ± standard deviation where appropriate. p <0..05 statistical significant difference
FBG: feeding bag group -IEFG: intermittent enteral feeding group

Table (7): Distribution of feeding bag (FB) and intermittent enteral feeding (IEF) groups according to total intake of water, protein and calories in the first day, 4th day and the last of the study.

	FBG (n=35)	**IEFG (n=35)**	**Z**	**P.value**
	Mean±SD	Mean±SD		
Water				
First day	414±145.07	750.33±177.25	-5.948	<0.001**
4th day	392.67±163.79	766.67±173.51	-6.184	<0.001**
Last day	467.67±156.64	798.33±225.96	-5.105	<0.001**
Protein				
First day	53.82±10.59	63.35±9.23	-3.435	0.001**
4th day	50.26±11.06	64.05±8.99	-4.484	<0.001**
Last day	48.45±11.88	64.39±8.79	-5.009	<0.001**
Calories				
First day	2003.33±352.8	2386.67±217.72	-4.374	<0.001**
4th day	2018.33±297.83	2381.67±214.35	-4.336	<0.001**
Last day	2030±280.27	2383.33±215.09	-4.413	<0.001**
Residual volume				
First day	23.67±24.7	2.33±3.65	-4.967	<0.001**
4th day	20.67±28.85	1.5±3.51	-5.579	<0.001**
Last day	19.33±29.44	0.43±1.36	-5.397	<0.001**

Note: Data is represented as mean ± standard deviation, p <0..05 statistical significant difference

Table (8): Distribution of feeding bag (FB) and intermittent enteral feeding (IEF) groups in relation to complications and duration of mechanical ventilation

	FB (n=35)	**IEF (n=35)**	**P. value**
	No (%)	**No (%)**	
Gastrointestinal complication			
Nausea and vomiting	28(80.0)	7(20.0)	<0.001**
Abdominal distension	31(88.6)	5(14.3)	<0.001**
Diarrhea	23(65.7)	14(40.0)	0.055
GI bleeding	3(8.6)	1(2.9)	0.609
Mechanical Complication			
Tube obstruction	6(17.1)	0(0.0)	0.033*
Tube dislodgement	0(0.0)	0(0.0)	-
Pulmonary aspiration	2(5.7)	0(0.0)	0.474
Metabolic complication			
Ca,Mg&K alterations	32(91.4)	21(60.0)	0.005**
Fluid electrolyte disturbances	32(91.4)	15(42.9)	0.001**
Hyperglycemia ,hypoglycemia	27(77.1)	11(31.4)	<0.001**
Duration of MV(Mean±SD**)**	9.05±3.47	4.33±1.23	0.001**

Notes: Data is represented as number (percentage) or mean ± standard deviation where appropriate. p <0..05 statistical significant difference, MV, mechanical ventilation

Table (1) illustrates descriptive characteristics of the patients in the feeding bag and intermittent enteral feeding groups. Regarding to age, it was noticed that the mean age in the feeding bag and intermittent enteral feeding groups are nearly similar (51.94 + 14.44 & 51.89 + 14.40) respectively and more than half of them (54.3% and 51.4%) in both groups respectively their ages more than 55 years. As regard to sex, it was noticed that more than half on feeding bag group were male and more than two third on intermittent enteral feeding group were male. No significant statistical difference was put into evidence between the two studied groups in relation to age and sex and there was no a significant statistical difference between the two groups in relation to present illness.

Table (2) shows hemodynamic monitoring of FB and IEF groups. It can be noted that there was no statistically significant difference between the two groups regarding the majority items of hemodynamic

monitoring except temperature and MAP. As regard to temperature, it was found that there was a statistical significant difference between FB and IEF groups on the 4th day and the last day of the study (P=0.019 &0.023). As regard to MAP, it was noticed that there was a statistical significant difference between FB and IEF groups in the first day of the study and on the 4th day of the study (P = 0.026 &0.034) respectively.

Table (3) shows Physical examination of both groups. It can be noted that there was no a statistical significant difference between FB and IEF groups (P-value > 0.05) except wheezing, dry mucous membrane, site and degree of edema.

Table (4) illustrates that there were no statistical significant differences between feeding bag and intermittent enteral feeding groups regarding the majority items of chest x-ray findings and duration of mechanical ventilation (P-value > 0.05).

Table (5) shows that there was highly statistical significant difference between the two groups in relation to laboratory findings in the last day regarding HB, WBC, Calcium, majority items of liver functions and there was a statistical significant difference between the two groups regarding platelets and $Paco_2$ (P < 0.05).

Table (6) show that there was no a significant statistical difference between the two groups regarding intake, output, fluid balance in all the period of the study (P > 0.05)

Table (7) shows that there was highly statistical significant difference between the two groups in relation to intake of water, protein and calories in the first day, 4th day and the last of the study (P < 0.001)**.**

Table (8) shows that there was highly statistical significant difference between the two groups in relation to the majority items of complication and duration of mechanical ventilation (p < 0.005)

Discussion

There are many enteral feeding guidelines applied to ICU patients and vary from institution to institution according to the protocol which this institution followed, to choose the best protocol to take it as standard method to be practiced, this needs different studies to evaluate which one is better, have lesser complications and more tolerant to ICU patients. Hence, the present study aims to compare the effect of intermittent enteral feeding by using syringe pump versus hospital blended formula by using feeding bag on the nutritional status and complications among ICU patients at Assiut University Hospitals**.(Shankar et al., 2015)**

Regarding the nutritional status of the patients, this study revealed that there was a significant difference between the two groups which was appeared in the results of physical examination and laboratory findings as the intermittent enteral feeding group was better than feeding bag group regarding degree of edema, total requirement of water, protein and calories per day which was reflected on the biochemical parameters

as the serum total protein and albumin. This can be attributed to the intermittent enteral feeding by using syringe pump to facilitate slow introduction of feed was the best method to administer the full regimen and achieved standard formula without deficiency as the development of complications like vomiting, diarrhea was lesser in the intermittent enteral feeding group**. (Reintam, 2017 and Bozzetti and Tagliabue, 2017).**

This come in line with **(Marianne and Shunker, 2019)** who documented that slow introduction of enteral feeding decrease the risk of refeeding syndrome and occurrence of complications like vomiting and diarrhea.

Patients with enteral feeding are at risk for developing many complications which may be gastrointestinal, mechanical or metabolic complications. Gastrointestinal complications (GICs) include nausea, vomiting, diarrhea, constipation, abdominal distension and GI bleeding are most common among patients received enteral feeding **(Rosdahl and Kowalski 2012).**

The present study indicated that decreasing the administration rate of feed with using syringe pump with continuous feed over 24hrs was significantly effective in decreasing the incidence of GIC_S as the results showed that there was highly a statistical significant difference between both groups regarding GIC_S. This agrees with **(Reda and Ibrahim, 2000)** who found out that the rapid infusion rate, improper patient position, and cold formulas were the most common causes of vomiting in their study. Also this agree with study done by **(Galindo et al., 2006)** who stated that intermittentfed patients are lesser to develop vomiting and diarrhea than patients who feeding can be stopped for hours like in the feeding bag group. In this respect, **(El-Baz, Reda and El-Soussi, 2003)** stated that slow rate of feed administration is the relieving factor of vomiting.

(Hucl, and Spicak, 2016) mention that Metabolic complications of enteral feeding like electrolytes disturbance, hypoglycemia and hyperglycemia are common and usually associated with GIC_S. Hence, in the present study, it was found that there was highly statistically significant difference between both groups regarding metabolic complications as intermittent enteral feeding group had lesser metabolic complications than feeding bag group. This can be attributed to intermittent enteral feeding group had lesser GIC_S so they had lesser metabolic complications.

Conclusion

Based on the results of this study, it could be concluded that intermittent enteral feeding by using syringe pump is extremely effective in reducing complications and improving the nutritional status among ICU patients than the hospital blended formula by using feeding bag.

Recommendations:

- Emphasize the importance of applying intermittent enteral feeding on reducing complications and duration of mechanical ventilation among ICU patients.

- Intermittent enteral feeding should be used as standard enteral feeding for patients in the intensive care units.
- Update the critical care nurses knowledge about different routes of enteral feeding
- Apply evidence based practice to reduce enteral feeding complications.

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